

## Canaveral Port Authority 2016 TIGER VIII Benefit Cost Analysis Methodology Documentation – Inland Port Logistics Center Road Improvements

This document outlines the methods and assumptions utilized in the calculation of key benefits for the benefit-cost analysis that supports the Canaveral Port Authority's (CPA) Inland Port Logistics Center Road Improvements TIGER VIII Grant application. This documentation complements the Benefit-Cost Analysis Spreadsheet which provides the detailed calculations based on the assumptions and methodologies described below.

The elements of the benefits relate to those determinable by anticipated freight transportation operations with and without the project, and correlate with key selection criteria outlined by the US Department of Transportation (DOT). The Inland Port Logistics Center Road Improvements Project is to support the development of an Inland Port Logistics Center (ILC) by increasing the capacity of key external and internal roadways serving the facility. This roadway network supports developments by both CPA and Wal-Mart.

### I. Purpose of Benefit Cost Analysis (BCA)

DOT has stressed five key selection criteria and goals to be evaluated as part of the TIGER VIII Grant process. The supporting BCA is organized as follows:

#### a. State of Good Repair

The State of Good Repair will be comprised of the value of avoided roadway pavement damage due to reduced truck vehicle-miles traveled (VMT) from shorter haul movements for cargo handled at Port Canaveral and the ILC versus from more distant seaports and their ILCs.

#### b. Economic Competitiveness

The Economic Competitiveness is measured based on two factors: travel time savings for truck drivers; and savings on truck operating costs including maintenance and fuel. The savings is based on reduced VMT.

#### c. Quality of Life

The quality of life criteria is focused on land use choices that reduce VMT, increased accessibility, and property value increases. The ILC will increase the value of the property it is developed on, will provide access to new high paying jobs, and will help reduce VMT on U.S. roadways. While this project will increase the value of the developed land, these benefits were not included as part of the total final benefits, resulting in a more conservative BCA.

#### d. Environmental Sustainability

The environmental sustainability criteria is focused on environmental benefits from reduced emissions. This project promotes environmentally sustainable transportation by decreasing truck VMT and reducing emissions and fuel consumption.

#### e. Safety

The safety criteria is focused on prevented accidents (property damage), injuries, and fatalities. The proposed project would contribute to promoting DOT's long-term safety goals through decreasing the likelihood and cost of accidents by reducing truck VMT.

## II. Spreadsheet Structure

The attached Excel spreadsheet is comprised of multiple sheets containing pertinent information for the Benefit Cost Analysis (BCA). The following provides a brief overview of each of these sheets:

- Monetized Values and Factors – This sheet is predominately comprised of values and factors provided by the BCA Resource Guide 2016. This information is supplemented with other necessary factors and monetized values such as pavement damage and truck operating costs.
- CPI – This sheet is a reference in order to convert all values into the same year of expenditure as provided by the U.S. Department of Labor.
- Emissions – This sheet contains information from the California Life-Cycle Benefit/Cost Analysis Model Version 5.0 for truck emissions. The provided values of 2011 and 2031 were interpolated to determine values for additional years for the average speeds of each movement type.
- Safety – The Safety sheet provides factors necessary to calculate the number of fatalities, injuries, and property damage only incidents based on national averages for vehicle miles traveled. These safety factors were determined from available data from the Federal Highway Administration (FHWA) and the Federal Motor Carrier Safety Administration (FMCSA).
- Project Costs – This sheet details at a high level the overall project costs included as part of this BCA. In addition to the roadway infrastructure cost, the cost of developing both the Port Canaveral and Wal-Mart warehouse and distribution center facilities was incorporated as these components are necessary for the entire project to be a reality yet are not included as part of this grant ask.
- With and Without Scenario – This sheet shows the timeframe for the development of the warehouse and distribution space which result in an incremental increase in truck movements from 2019 to 2028 and are held constant throughout the remainder of the 20 year life cycle.
- 20 Year Forecasts and Benefits – This sheet is where the final calculations for each of the benefits is performed. This is predominately based around truck vehicle miles traveled (VMT) and truck ton-miles traveled. The remainder of this documentation describes the calculations involved in this process.

## III. Analysis Years and Other Baseline Assumptions

### a. Length of Benefit

The benefits were calculated based on a 20-year project life cycle. The assumed start date for benefits associated with warehouse and distribution space development are shown in Table 1 below. The 20 year life cycle is based on the roadway construction which will be completed with the requested Grant money. The life cycle of the proposed warehouse developments is anticipated to go beyond 20 years, but benefits for those additional years are not included and capped at the life cycle of the roadways. This results in a more conservative estimate for the BCA.

Table 1 Benefit Analysis Years Based on Distribution Center Capacity

Year	Port Canaveral Development (sq. ft.)	Wal-Mart Development (sq. ft.)	Total (sq. ft.)
2019	-	460,000	460,000
2020	180,000	-	180,000
2021	180,000	-	180,000
2022	60,000	-	60,000
2023	180,000	-	180,000
2024	180,000	-	180,000
2025	60,000	-	60,000
<b>Total</b>	<b>840,000</b>	<b>460,000</b>	<b>1,300,000</b>

**b. Monetized Value Assumptions**

As specified in the TIGER Benefit Cost Analysis (BCA) Resource Guide, the benefits were estimated utilizing fixed values. These include the value of injuries (determined by the severity of the injury), value of property damage without injury, and the value of travel time for truck drivers. Emissions values were also specified in the document for carbon dioxide, volatile organic compounds, nitrogen oxides, particulate matter and sulfur dioxide. In addition this BCA includes fixed values for truck payloads, fuel consumption, truck operating costs, and pavement damage. The project costs were provided by CPA, Wal-Mart, and industry average development costs for warehousing space. This includes individual schedules for benefit years for each development as described above. Project and maintenance costs include a discount that utilizes a 3 percent and 7 percent discount rate to determine the aggregate present value. This discount was also applied to future year benefits.

**IV. Project Benefits Assumptions and Results**

A summary of all project benefits calculations, CPA cost estimates, and truck trip/cargo projections are provided in the Excel File included as part of this submittal.

**Commodity Flow and Market Analysis Assumptions** – To determine the impact of this development, two key assumptions were required: total cargo served by these facilities and the net change in distance between where this cargo is imported with and without the project.

The Institute of Transportation Engineers (ITE) Trip Generation Manual 8th edition was used to estimate general and truck trips to be generated by the proposed ILC. Based on the development schedules and truck trip generation rates for high-cube warehouse, truck traffic was estimated for the proposed development. These truck trip estimates were the basis for the benefit cost analysis and were used to determine changes in vehicle miles traveled and the like. The number of truck trips (or new demand) remains the same with and without this project, however, the distance these trucks must travel to access the Orlando market changes and this is where the benefits are realized. It is assumed that as soon as a warehouse is developed at the proposed ILC, truck trips will be generated.

For the Port Canaveral development, benefits associated with this project are related to truck trips moving cargo from Port Canaveral to the ILC then eventually to the Orlando market. For Wal-Mart, benefits are affiliated with a small portion of the refrigerated goods processed at the facility being imported through Port Canaveral instead of the traditional importation through the Port of Philadelphia. It is assumed that, beginning in 2020, 1 percent of the total refrigerated cargo handled at this facility will be imported through Port Canaveral. This will increase in the amount of 0.5 percent per year through 2028 up to 5 percent and then held constant at this 5 percent for the remainder of the benefit years.

For the difference in distance calculation, the following provides, in brief, the steps involved.

- 1) Average trip distance tables were established using origin/destination to/from Orlando for each development,
- 2) Average trip distance was weighted based on utilization of alternative ports based on CPA guidance, and
- 3) an average weighted trip distance was compared to what an average trip distance would be from CPA to/from Orlando in a build scenario.

If the warehouses are not developed at the proposed site due to transportation infrastructure insufficiency (without project), the portion of market demand that cannot be served by the proposed site and Port Canaveral will be served by long haul trucks from ILCs serving Port of Savannah (30%), Jaxport (30%), Port Everglades and Port Miami (30% total), and Port Tampa Bay (10%). While the total number of truck trips generated remains the same under with and without grant scenarios, the distance traveled by each truck increases significantly without the project. For the Wal-Mart traffic, the cargo will be handled by the Port of Philadelphia instead of Port Canaveral, also resulting in a significant increase in VMT.

The methodology and average distances are shown in Figure 1 below. For the development component related to Port Canaveral, the average reduction in distance is 172 miles per trip (205 average miles from other ports less 33 miles from CPA and ILC). For Wal-Mart produce, the reduction is 986 miles per trip (999 miles from Port of Philadelphia to the ILC less 13 miles from Port Canaveral to the ILC).

Average Truck Trip Distance Calculation Methodology:

- Typical ILC Generated Truck Flows



Percent of Truck Trips to/from the ILC and the Market: X%  
 Percent of Truck Trips to/from the ILC and the Port: Y%  
 $X\% + Y\% = 100\%$   
 Average Truck Trip Distance =  $X\% * A + Y\% * B$

Calculation Assumptions and Steps:

Ports	Distance A (miles)	Distance B (miles)	X%	Y%	Market Share	Average Distance (miles)
Truck Trips through Proposed Logistic Park						
Port Canaveral	46	13	60%	40%	100%	<b>33</b>
Truck Trips through ILCs of Other Ports						
Port of Savannah	282	0	50%	50%	30%	<b>205</b>
Jaxport	148	0	50%	50%	30%	
Port Everglades/Port Miami	227	0	50%	50%	30%	
Port Tampa Bay	84	0	50%	50%	10%	
Truck Trips through Other Ports for Wal-Mart Products						
Port of Philadelphia	999	0	50%	50%	100%	999

Assumptions:

1. Distance A and B for truck trips through the proposed site are measured distances between Orlando and the proposed site location, and between the proposed site location and Port Canaveral. Distance A for truck trips through ILCs of other ports are measured distances between Orlando and the ports assuming all ILCs are closely located around their Ports.
2. X% and Y% are estimated based on the mix of trucks (single-unit trucks vs. combination trucks) generated given the ILC's distance from the Orlando Metro Market

**Figure 1: Methodology to Calculate Average Truck Trip Distance**

Source: Canaveral Port Authority and Cambridge Systematics, Inc.

Tonnage and vehicle averages were devised using standard commercial vehicle configurations for each commodity type to establish a tons or TEU per truck calculation. The combination of these factors allows for a calculation of the change in vehicle miles traveled as a result of this project as well the change in ton-mileage and truck driver travel time.

**Project Maintenance Assumptions** – A maintenance factor of 0.5% was applied to the total project cost for CPA and Wal-Mart components, amounting to \$874,035 annually, beginning ramp up three years after the initial expenditure. Maintenance was also discounted by 3% and 7%.

**State of Good Repair Results** – The State of Good Repair will be comprised of the value of avoided roadway pavement damage due to reduced truck vehicle-miles traveled (VMT) from shorter haul movements for cargo handled at Port Canaveral and the ILC versus from more distant seaports and their ILCs. The development of the ILC will reduce truck VMT by replacing long haul movements from distance seaports with short haul truck movements moving from Port Canaveral to the ILC and from the ILC to the Orlando Metro Market. Similarly, it is anticipated that some small amount of refrigerated goods handled by the Wal-Mart distribution center will be imported through Port Canaveral in the future resulting from the new cold treated produce now able to be imported to Florida directly through Florida seaports.

The calculation measures the avoided truck VMT created by moving cargo through Port Canaveral and the ILC based on average pavement damage cost per truck mile of travel. By reducing truck VMT by 555.5 million miles, the total state of good repair benefit is \$97.7 million (non-discounted) in avoided pavement damage over the 20 year analysis period.

**Economic Competitiveness Results** – The Economic Competitiveness is measured based on two factors: travel time savings for truck drivers; and savings on truck operating costs including maintenance and fuel. Travel time savings are based on the total change in vehicle miles traveled (VMT) divided by the average speed and multiplied by the hourly value of travel time savings provided by the BCA Resource Guide. Operating costs are also directly impacted by the change in VMT and represent the cost of truck operations, including fuel, repair and maintenance, and tires. This component of the benefit analysis yielded the largest overall results in the amount of \$663.2 million in total savings over the 20 year analysis period.

**Environmental Sustainability Results** – The environmental sustainability criteria are focused on environmental benefits from reduced emissions. This project promotes environmentally sustainable transportation by decreasing truck VMT and reducing emissions and fuel consumption. Table 2 summarizes total project results for environmental benefits which were then monetized using the value of emissions provided by the BCA Resource Guide.

*Table 2. Community and Environmental Benefits with Project*

Avoided Emissions	Metric Tons
Net Reduction in CO <sub>2</sub>	342,525
Net Reduction in Volatile Organic Compounds (VOCs)	68
Net Reduction in Nitrogen Oxides (NO <sub>x</sub> )	221
Net Reduction in Particulate Matter (PM)	29
Net Reduction in Sulfur Dioxide (SO <sub>x</sub> )	4

**Safety Analysis Results** – The safety criteria are focused on prevented accidents (property damage), injuries, and fatalities. The proposed project would contribute to promoting DOT’s long-term safety goals by decreasing the likelihood and cost of accidents through a reduction in truck VMT. Table 3 displays safety improvements, along with monetized safety benefits resulting from increased safety in the build scenario.

*Table 3. Safety Benefits with Project*

	Quantity
Fatalities Avoided	8
Injuries Avoided	195
Property Damage Only Avoided	535
Monetized Safety Benefits (non-discounted)	\$169.0 million

## V. Summary of Project Benefits

A summary of all project benefits is shown in Tables 4 below. This table also includes the total of the benefits discounted at 3 and 7 percent, with Carbon emissions held at 3 percent per TIGER guidance.

*Table 4. Total Monetized Benefits with Build (non-discounted)*

Monetized Non-Discounted Benefits	Benefits
<b>State of Good Repair</b>	\$ 97.7 million
<b>Economic Competitiveness</b>	\$663.2 million
<b>Community and Environmental Outcomes</b>	
Sustainability (Less Carbon Emissions)	\$12.7 million
Carbon Emissions (Discounted at 3%) <sup>1</sup>	\$19.5 million
<b>Safety</b>	\$169.0 million
<b>Total in Non-Discounted Dollars (Less Carbon Emissions)</b>	\$942.7 million
<b>Total Benefits Discounted at 3%</b>	\$629.5 million
<b>Total Benefits Discounted at 7% (with Carbon held at 3%)</b>	\$378.8 million

<sup>1</sup> Carbon Emissions are held to a constant discount of 3 percent based on guidance from the *Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*.

Table 5 details the total costs associated with this project. While the TIGER VIII grant funding would only support the cost of the roadway improvements associated with the project, additional development costs were included. Primarily this includes the cost of developing the warehouse and distribution centers for both Wal-Mart and CPA as these buildings are necessary in order to realize the benefits of this project. Table 5 also includes the total benefits and final benefit cost ratio for this project. At a 3 percent discount, the benefit cost ratio was determined to be 3.7. At a 7 percent discount it is 2.9. This signifies a positive benefit associated with this project.

*Table 5. Total Project Costs and Benefits with Build and Final BCA*

<b>Project Costs</b>	
<b>Roadway Improvement Cost</b>	\$20,106,900
<b>Wal-Mart Development</b>	\$96,200,000
<b>CPA Development</b>	\$63,000,000
<b>Maintenance</b>	\$14,270,121
<b>Total Project Costs (including maintenance)</b>	\$193,577,021
<b>Total Costs Discounted at 3%</b>	\$170,121,102
<b>Total Costs Discounted at 7%</b>	\$ 131,722,546
<b>Total Benefits</b>	
<b>Total Benefits Discounted at 3%</b>	\$629.5 million
<b>Total Benefits Discounted at 7% (with Carbon held at 3%)</b>	\$378.8 million
<b>Benefit Cost Ratio</b>	
<b>3% Discount</b>	<b>3.7</b>
<b>7% Discount</b>	<b>2.9</b>



## VI. Sources of Methods for Benefit Analysis

### **Economic Outcomes Sources:**

- Value of Travel Time: TIGER BCA Guidance
- Truck Operating Costs: *An Analysis of the Operational Costs of Trucking: A 2015 Update*, American Transportation Research Institute, September 2015. Costs include fuel, repair and maintenance, and tires.
- Truck Driver Travel Time: TIGER BCA Guidance

### **Mobility Outcomes Sources:**

- Pavement Damage: *Pricing Freight Transport to Account for External Costs*, Congressional Budget Office Working Paper 2015-03, March 2015

### **Safety Outcomes Sources:**

- Value of Statistical Life: TIGER BCA Guidance
- Value of Injuries: TIGER BCA Guidance
- Property Damage Only Crashes: TIGER BCA Guidance

### **Community and Environmental Outcomes Sources:**

- Value of Emissions: TIGER Guidance
- Social Cost of Carbon: TIGER Guidance
- Truck Fuel Consumption: *2014 Vehicle Technologies Market Report*, Oak Ridge National Laboratory, U.S. Department of Energy, May 2015